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Symmetrical Components and Fault Analysis

Objective
This three-day school is designed to provide a comprehensive coverage of symmetrical components, their application in relay design, and performance analysis. The school discusses the symmetrical component representation of various power system components, and comprehensively analyzes faults.

Relay segments covered:
- Per unit system
- Introduction to symmetrical components
- System faults
- Fault calculations
- Sequence network modeling: Generator
- Sequence network modeling: Transformer
- Sequence network modeling: Overhead lines

Participants Learn
- Mathematical fault analysis techniques
- Fault calculations and system stability for single and multiple fault scenarios
- Understand real case examples
- Rapid calculation of how your system will behave under extreme conditions

Participant Profile
Engineers and Senior Level Technicians who wish to reacquaint themselves with vector mathematics and fault analysis computations

Prerequisites
A general knowledge of basic electrical engineering is recommended, as well as Elementary Vector Mathematics, Mathematical Matrix Manipulation, and Power System Basics

What to Bring
Only Scientific Calculator

Basic Relay School (Distribution Protection)

Objectives
This five-day school provides comprehensive relay application principles on distribution protection. Personalized hands-on training with ABB application engineers, using real-world examples, allows participants to practice each theory with fault simulators and relays.

Training segments covered:
- Introduction to Protective Relaying
- Phasors, Polarity, Per Unit system, and basic Power concepts
- Review of Symmetrical Components
- Relay Input Sources
- Overcurrent and Directional Overcurrent protection
- Feeder, Transformer, Motor, and Arc Flash protection
- Auto Reclosing
- Digital Relays
- Relay Testing

Participants Learn and Perform Hands-On
- Distribution network protection, system design and implementation
- Distribution equipment protection, system design and implementation
- Apply theory to real system examples
- Protection theory and practice on microprocessor based relays and electromechanical relays

Participant Profile
Electrical Engineers, Relay Engineers, and Senior Technicians.

Prerequisites
Knowledge of basic electrical engineering is required. Symmetrical Component School is recommended.

What to Bring
Only Scientific Calculator
Advanced Relay School (Transmission Protection)

Objectives
This five-day school provides comprehensive relay application principles on transmission protection. Personalized hands-on training with ABB application engineers, using real-world examples, allows participants to practice each theory with fault simulators and relays.

Training segments covered:
- Review of symmetrical components
- Relay input sources
- Digital relays
- Directional element
- Distance protection
- Pilot schemes
- Phase comparison protection
- Current differential protection
- Relay performance evaluation

Participants Learn and Perform Hands-On
- How to design and implement a transmission line protection system
- Apply theory to real world examples
- Protection theory and practice on microprocessor based relays and electromechanical relays
- Current differential protection
- Phase comparison or distance protection
- Pros and cons of each protection scheme

Participant Profile
Relay Engineers, Protection Engineers, Technicians and Operators

Prerequisites
Knowledge of or experience on protective relaying is required. Symmetrical Component School or Distribution Protection School is recommended.

What to Bring
Laptop and digital multimeter are recommended

Basic Automation School

Objectives
This three-day school provides basic substation automation application principles on power systems. Personalized hands-on training with ABB application engineers, using real-world examples, allows participants to practice each theory with RTU simulators and relays.

Training segments covered:
- Introduction to Substation Automation
- OSI Layer model
- Basic TCP/IP principles
- DNP Protocol overview and exercises
- Modbus Protocol and exercises
- IEC 61850 overview

Participants Learn and Perform Hands-On
Substation Automation, system design and implementation
- Apply theory to real system examples
- Communication theory and practice on microprocessor based relays and RTU simulators

Participant Profile
Relay Engineers, Communication/Automation Engineers, and Senior Technicians

Prerequisites
Knowledge of basic electrical engineering and computers is required.

What to Bring
Laptop with Ethernet port and user account with administrator rights.
Advanced IEC 61850 School

Objectives
This two-day training program is on the protocol IEC 61850, the communication standard for substation automation systems.
The main objectives are:
- Summarize the basics of communication and the functions of substation automation, including protection
- Summarize the properties of the signal data flow in a substation from the power process level (switch yard) through the bay and station level, up to the network level
- List the requirements and understand the need for a communication standard in substations
- Describe the approach of IEC 61850
- Understand the role and application of the Substation Automation Configuration Description Language (SCL)
- Explain all parts of the standard and their relationships

Contents
- ISO/OSI model
- Control levels, communication path IEC 61850
- The Data model: objects, data, and attributes communication services
- The communication stack: MMS, TCP/IP, Ethernet
- The application of the standard: modeling of functions, systems, and switchgear communication topologies
- The benefit of IEC 61850: examples for advanced functionality and the cost reduction potential

Hands-on Training
Build an IEC 61850 Substation Automation system
Configure GOOSE control

Participant Profile
Consultants and employees from the electricity supply industry

Prerequisites
Engineering degree, technical college qualifications or equivalent; basic knowledge of Protection and Substation Automation

What to Bring/Additional Courses
Laptop is recommended

Distribution Protection Units DPU2000R/MSOC/REF550

Objectives
This two-day training program is designed for participants to become proficient in application, installation, operation, and testing of ABB Distribution Relays. Our mission is to train a new and changing Power Utility workforce to become experienced in the ABB DPU2000R, MSOC, and REF550 through the use of personalized, hands-on training.
Training segments:
- Download/upload settings
- Save/View records and waveforms
- Become familiar with WinECP, WinFPI and WaveWIN
- Upgrade software, hardware, and the relay
- Test and troubleshoot
- Use optional features
- Communicating to the relay

Participants Learn and Perform Hands-On
- Applications: learn to apply relays for various situations
- Settings: set up relay functions for your specific application
- Acceptance Testing: test relays to verify acceptance criteria and characteristics
- Troubleshooting Techniques: use relay tools to reduce operating costs and minimize downtime
- Complete protection, common look and feel

Product Highlights
- Advanced feeder protection
- Optional synch-check
- Optional Sensitive Earth Fault (SEF) protection
- Common control and automation features

Participant Profile
Relay Engineers, Technicians, and Operators

Prerequisites
Knowledge of/experience with Protective Relaying and use of electrical equipment

What to Bring
Laptop with serial port or USB-serial converter, serial cable, and null modem adapter are required.
Feeder Protection Unit (REF 615)

Objectives
This two-day training program is designed for participants to become proficient in application, installation, operation, and testing of ABB REF 615 relay. Our mission is to train a new and changing Power Utility workforce to become experienced in ABB’s REF615 relays using personalized, hands-on training.

Training segments include:
- Basic relay operation
- Relay settings
- Setting up and communicating with the relay
- Testing and troubleshooting
- Using optional features
- Upgrading the relay

Participants Learn and Perform Hands-On
- Applications: learn to apply relays for various situations
- Settings: set up relay functions for your specific application
- Acceptance Testing: test relays to verify acceptance criteria and characteristics
- Troubleshooting Techniques: use relay tools to reduce operating costs and minimize downtime
- Superior arc protection
- IEC 61850 REF615 model

Product Highlights
- REF615: is the fastest, most powerful product in its class aligned for the protection, measurement and supervision of utility substations and industrial power systems. Engineered from the ground up, the REF615 has been designed to unleash the full potential of the IEC 61850 standard for communication and interoperability of substation automation devices.

Participant Profile
Relay Engineers, Technicians, and Operators

Prerequisites
Knowledge of/experience with Protective Relaying and use of electrical equipment

What to Bring
Laptop computer with Ethernet port and user account with administrator right is required.

Arc Protection System (REA10_)

Objectives
This one-day training program is designed for participants to become proficient in application, installation, operation, and testing of ABB Arc Protection Relays. Our mission is to train a new and changing Power Utility workforce to become experienced in REA101, 103, 105 and 107 using personalized, hands-on training.

Training segments include:
- Basic relay operation
- Loop-type or radial optical fiber for arc detection
- High speed semiconductor outputs for tripping
- Relay settings
- Setting up and communicating with the relay
- Testing and troubleshooting
- Using additional features
- Upgrading the relay

Participants Learn and Perform Hands-On
- Applications: learn to apply relays for various situations
- Settings: set up relay functions for your specific application
- Acceptance Testing: test relays to verify acceptance criteria and characteristics
- Troubleshooting Techniques: use relay tools to reduce operating costs and minimize downtime
- Compliance with new US OSHA regulations
- To reduce catastrophic events

Product Highlights
- Unique, maintenance free fiber optic technology
- Three-phase overcurrent, circuit breaker, and selective tripping
- Perfect solution for retrofit and new installations
- Fast trip time (< 2.5 ms) with semi-conductor outputs

Participant Profile
Relay Engineers, Technicians, and Operators

Prerequisites
Knowledge of/experience with Protective Relaying and use of electrical equipment

What to Bring
Laptop is recommended
Objectives
This one-day training program is designed for participants to become proficient in application, installation, operation, and testing of ABB Transformer Relays. Our mission is to train a new and changing Power Utility workforce to become experienced in the ABB TPU2000R using personalized, hands-on training.

Training segments include:
- Download/upload settings
- Save/View records and waveforms
- Become familiar with WinECP, WinFPI and WaveWIN
- Upgrade software, hardware, and the relay
- Test and troubleshoot
- Use optional features
- Communicating to the relay

Participants Learn and Perform Hands-On
- Applications: learn to apply relays for various situations
- Settings: set up relay functions for your specific application
- Acceptance Testing: test relays to verify acceptance criteria and characteristics
- Troubleshooting Techniques: use relay tools to reduce operating costs and minimize downtime
- Common control and automation features

Product Highlights
- Two and three winding protection
- Differential protection characteristics
- Complete protection, common look and feel

Participant Profile
Relay Engineers, Technicians, and Operators

Prerequisites
Knowledge of/experience with Protective Relaying and use of electrical equipment

What to Bring
Laptop is recommended

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Objectives
This one to five-day training program is designed for participants to become proficient in application, installation, operation, maintenance, and testing of ABB Electromechanical Relays and FT Switches. Our mission is to train a new and changing Power Utility workforce to become experienced in these products using personalized, hands-on training.

Training segments include:
- Current non-directional and current directional
- Distance
- Current differential
- Auxiliary and annunciator
- Under/over voltage
- Power directional
- Under/over frequency
- FT Switches

Participants Learn and Perform Hands-On
- Applications: learn to apply relays for various combinations of fault protection
- Settings: set up relay functions for your specific application
- Maintenance: maintain relays to perform for a lifetime
- Calibration: calibrate relays to precision accuracy
- Acceptance Testing: test relays to verify acceptance criteria and characteristics
- Relay Construction: learn cylinder unit, induction disc element, transformer, compensator, polar unit and auxiliary relay components
- Troubleshooting Techniques: use relay tools to reduce operating costs and minimize downtime

Participant Profile
Relay Engineers, Technicians, and Operators

Prerequisites
Knowledge of/experience with Protective Relaying and use of electrical equipment

What to Bring
Laptop and digital multimeter are recommended
Basic HMI and Communication Gateway (COM600)

Objectives
A one day training program designed for a technician to become proficient in installation and operation of the COM600 gateway/HMI. Our mission is to train a new and changing Power Utility work force to become experienced in ABB’s Substation Automation COM600 Series of products using personalized, hands-on training.

Training segments include:
- Hardware identification and configuration
- Operating the COM600, both locally and remotely
- License upgrade

Participants Learn and Perform Hands-On:
- Setting up COM600 computer
- Upload and download configuration from/to COM600
- How to use Event and Alarm list, automatic disturbance file uploading from IED
- How to use Web HMI
- How to test communication, both Master and Slave
- Troubleshooting Techniques

Product Highlights
- COM600: Gateway and/or HMI
- Variety of communications protocols supported including IEC61850
- Simple configuration and commissioning
- Bottom up engineering approach

Advanced HMI and Communication Gateway (COM600)

Objectives
A two day training program designed for engineers and technicians to become proficient in the advanced features, configuration and operation of the COM600 gateway/HMI. Our mission is to train a new and changing Power Utility work force to become experienced in ABB’s Substation Automation COM600 Series of products using personalized, hands-on training.

Training segments include:
- Configuring Master and Slave communication
- Configuring HMI
- How to implement advanced features of COM600
- Cyber Security measures using COM600

Participants Learn and Perform Hands-On:
- Learn where and how to apply COM600 to various applications
- Configuring HMI
- Set up communications networks for your specific application
- Configure and apply HMI functions utilizing ABB Connectivity Packages and third party devices.
- How to use advanced functionalities such as Trending, IEC61131-3 programming for wide variety of applications
- Security and NERC CIP using COM600
- Troubleshooting Techniques

Product Highlights
- COM600: Gateway and/or HMI
- Variety of communications protocols supported including IEC61850
- Simple configuration and commissioning
- Bottom up engineering approach
Relay Product Training

Line Distance Protection (REL 670)

Objectives
This two-day training program aims to train the participants on line distance protection REL 670 and Protection and Control Manager PCM 600. The course focuses on application, setting calculation, configuration design and commissioning of line distance protection REL 670. Our mission is to train a new and changing Power Utility workforce to become experienced in the ABB REL 670 through the use of personalized hands-on training. Training segments include:
- Basic theory:
  - Distance protection, phase selection, switch onto fault
  - Pilot scheme
  - Loss of Potential, power swing
  - Autorecloser, synchronism check
  - Fault locator
- Hands-on exercises:
  - Setting and testing the above functions
  - System test on relevant functionality of pre-configured REL 670

Participants Learn and Perform Hands-On
- Applications: learn to apply relays for various situations
- Settings: set up relay functions for your specific application
- Acceptance Testing: test relays to verify acceptance criteria and characteristics
- Troubleshooting Techniques: use relay tools to reduce operating costs and minimize downtime

Product Highlights
- Versatile/meets all applications - IEC 61850
- Advanced DFR function
- HMI graphic with single line diagram representation and easy control of circuit breakers, disconnect switches...

Participant Profile
Relay Engineers, Technicians, and Operators

Prerequisites
Knowledge of/experience with Protective Relaying and use of electrical equipment

What to Bring
Laptop is recommended

Line Differential Protection (RED 670)

Objectives
This two-day training program trains participants on line differential protection RED 670 and Protection and Control Manager PCM 600. The course focuses on application, setting calculation, configuration design and commissioning of line differential protection RED 670. Our mission is to train a new and changing Power Utility workforce to become experienced in the ABB RED 670 through the use of personalized hands-on training. Training segments include:
- Basic theory:
  - Line differential
  - Time synchronization and line differential protection philosophies
  - Autorecloser, synchronism check
- Hands-on exercises:
  - Setting and testing the above functions
  - System test on relevant functionality of pre-configured RED 670

Participants Learn and Perform Hands-On
- Applications: learn to apply relays for various situations
- Settings: set up relay functions for your specific application
- Acceptance Testing: test relays to verify acceptance criteria and characteristics
- Troubleshooting Techniques: use relay tools to reduce operating costs and minimize downtime

Product Highlights
- Versatile/meets all applications - IEC 61850
- Advanced DFR function
- HMI graphic with single line diagram representation and easy control of circuit breakers, disconnect switches...

Participant Profile
Relay Engineers, Technicians, and Operators

Prerequisites
Knowledge of/experience with Protective Relaying and use of electrical equipment

What to Bring
Laptop is recommended
Relay Product Training

Bus Protection (REB 670)

Objectives
This two-day training program aims to train the participants on bus protection REB 670 and Protection and Control Manager PCM 600. The course focuses on application, setting calculation, configuration design and commissioning of bus protection REB 670. Our mission is to train a new and changing Power Utility workforce to become experienced in the ABB REB 670 through the use of personalized hands-on training.

Training segments include:
• Basic theory:
  » Bus differential protection
  » Breaker failure protection
• Hands-on exercises:
  » Setting and testing of the above functions
  » System test on relevant functionality of pre-configured REB 670

Participants Learn and Perform Hands-On
• Applications: learn to apply relays for various situations
• Settings: set up relay functions for your specific application
• Acceptance Testing: test relays to verify acceptance criteria and characteristics
• Troubleshooting Techniques: use relay tools to reduce operating costs and minimize downtime

Product Highlights
• Versatile/meets all applications - IEC 61850
• Advanced DFR function
• Advanced bus protection with the great performance

Participant Profile
Relay Engineers, Technicians, and Operators

Prerequisites
Knowledge of/experience with Protective Relaying and use of electrical equipment

What to Bring
Laptop is recommended

Transformer Protection (RET 670)

Objectives
This two-day training program aims to train the participants on transformer protection RET 670 and Protection and Control Manager PCM 600. The course focuses on application, setting calculation, configuration design and commissioning of transformer protection RET 670. Our mission is to train a new and changing Power Utility workforce to become experienced in the ABB RET 670 through the use of personalized hands-on training.

Training segments include:
• Basic theory:
  » Transformer differential protection
  » Restricted earth fault protection
  » Breaker failure protection
• Hands-on exercises:
  » Setting and testing the above functions
  » System test on relevant functionality of pre-configured RET 670

Participants Learn and Perform Hands-On
• Applications: learn to apply relays for various situations
• Settings: set up relay functions for your specific application
• Acceptance Testing: test relays to verify acceptance criteria and characteristics
• Troubleshooting Techniques: use relay tools to reduce operating costs and minimize downtime

Product Highlights
• Versatile/meets all applications - IEC 61850
• Advanced DFR function
• HMI graphic with single line diagram representation and easy control of circuit breakers, disconnect switches...

Participant Profile
Relay Engineers, Technicians, and Operators

Prerequisites
Knowledge of/experience with Protective Relaying and use of electrical equipment

What to Bring
Laptop is recommended
Objectives
This two-day training program aims to train the participants on generator protection REG 670 and Protection and Control Manager PCM 600. The course focuses on application, setting calculation, configuration design and commissioning of generator protection REG 670. Our mission is to train a new and changing Power Generating workforce to become experienced in the ABB REG 670 through the use of personalized hands-on training. Training segments include:

- **Basic theory:**
  - Generator differential protection
  - Unit Transformer differential protection
  - Overall differential protection
  - Generator backup protections
  - Generator abnormal operating condition protections

- **Hands-on exercises:**
  - Setting and testing the above functions

Participants Learn and Perform Hands-On

- Applications: learn to apply relays for various situations
- Setting: set up relay functions for your specific application
- Acceptance Testing: test relays to verify acceptance criteria and characteristics
- Troubleshooting Techniques: use relay tools to reduce operating costs and minimize downtime

Product Highlights

- Versatile/meets all applications – IEC 61850
- Advanced DFR function
- HMI graphic with single line diagram representation and easy control of circuit breakers, disconnect switches...

Participant Profile
Relay Engineers, Technicians, and Operators

Prerequisites
Knowledge of/experience with protective relaying and use of electrical equipment

What to Bring
Laptop is recommended

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Objectives
After this introduction/intermediate course participants will be familiar with the system architecture, functionality, and telecontrol protocol options of the Remote Terminal Unit RTU560. Users will be able to install RTUtil 560, the Remote Access Service (RAS from Microsoft), a dialup link and the Internet Explorer. The participant can communicate with the RTU560 via Internet Explorer, download and upload files, and diagnose the RTU560. Users can listen to telecontrol communication and record it. Participants can work with telegram filters, simulate a network control center, and import data from Excel-sheets. Attendees are introduced to function chart programming according IEC61131-3.

Contents

- RTUs as part of control systems
- Configuration options of RTU560A, RTU560C and RTU560E
- Hardware modules
- Software components
- Process data acquisition and telecontrol functions
- Exercises with the Windows-based tool RTUtil 560 for configuration, signal definition and parameterization
- Exercises with a PC-based tool for protocol simulation and analysis
- Diagnosis by the Internet Explorer
- Basics of TCP/IP, DNP 3.0, Modbus (and if required IEC 60870-5-101, IEC 60870-5-103 and IEC 60870-5-104)
- Interoperability
- Excel-Import
- Introduction in Integrated HMI
- Introduction in Programmable Logical Code

Participant Profile
Engineering, commissioning, and maintenance personnel

Prerequisites
Knowledge of general telecontrol functions and of MS Windows

What to Bring/Additional Courses
Laptop is recommended. Additional Courses available upon request: IEC 61131 PLC programming (advanced) 3 days, IEC 61850 protocol (advanced) 3 days, and customer-specific workshops.

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This course description concerns standard courses only. For tailor-made courses please refer to Training Administration. ABB reserves the right to make changes to standard courses without notice.
Remote Terminal Unit (RTU560 II)

Available Upon Request

Objectives
Participants, who have already worked with RTU560, RTUtil 560, and Internet Explorer, refresh their RTU knowledge in this advanced course. Topics include trouble shooting, router RTUs, ABB modems, redundancy options, protocols, and the latest release and new extensions of RTU560 systems, such as Web-HMI. Participants are able to parameterize the archive function and read archive data out of the RTU via Internet Explorer. Participants are able to connect a local printer to the RTU. The detailed program is customized with feedback from the participants.

Contents
- System integration of sub-RTUs
- Gateway functions
- Extension of racks, cabinets, configuration and parameters
- Modifications in network, signal, and hardware trees
- Adding the archive function
- Changing of boards during RTU-power ON
- Fault tracing and eliminating in an operating RTU560
- Diagnostic and maintenance via Internet Explorer
- Creation of a customized web page with single line diagram for switchyard control by personal computer
- Analyzing telecontrol communication based upon protocol DNP3.0, MODBUS and other (protocols on request: family IEC60870-5, SPAbus, ...)
- Introduction in 61850 protocol structure - used protocol elements
- Excel import of 61850 configurations into RTU560

Participant Profile
Engineering, commissioning, and maintenance personnel

Prerequisites
Attendance of the basic course RTU560 RPT012. Please specify which protocol you need at home (DNP3.0, MODBUS, IEC60870-5-101, 102, 103, 104, SPAbus, TG809, INDACTIC23, ...)

What to Bring/Additional Courses
Laptop is recommended. Additional Courses available upon request: IEC 61131 PLC programming (advanced) 3 days, IEC 61850 protocol (advanced) 3 days, and customer specific workshops.

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This course description concerns standard courses only. For tailor-made courses please refer to Training Administration. ABB reserves the right to make changes to standard courses without notice.
Registration Information
Please register for the course by using the Registration Form. Please make reservations at least two weeks before the start of the course, as we are only able to accept a limited number of participants on each course. We accept bookings in the order they arrive. To find course dates, please refer to the course descriptions or course schedule. Your credit card will not be charged prior to the first day of class.

Confirmation, facilities and accommodations
A confirmation will be returned upon receipt of your application with specific details about the hours, location, and lodging accommodations. We’ve negotiated the best rates available in each area during the ABB training program, please contact us for hotel information.

Cancellation and notice
If the course is cancelled or postponed, you will be informed at least one week prior to the course start. We reserve the right to postpone or cancel courses. If you need to cancel, please send an email to customer.supp@us.abb.com as soon as possible, but no later than three weeks prior to course start. The course fee will not be reimbursed to anyone canceling with less than three weeks notice from the scheduled course date.

Course certificate
Each participant will receive a course certificate upon the completion of the course.

Instructors and staff
Training is conducted by our professional instructors who are specialized in delivering the latest information and knowledge about the subject at hand.

On-Site and customized customer training
On-site and customized customer training sessions are offered upon request. We will gladly arrange courses at any agreed location. Our training staff will be happy to assist in the planning and organizing of your on-site or customized training requirements. Arrangements may also be made by contacting the Customer Support Department.